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REVIEWS

The Principles of Economic Geology. By W. H. EMMONS. New York: McGraw-Hill Book Co., Inc. Pp. 606, with 208 figures. 1918.

In *The Principles of Economic Geology* Professor Emmons has aimed to give advanced students of geology a general survey of the science of mineral deposits. The fuels have purposely been omitted, however, as to have treated them adequately would have enlarged the book unduly, and evidently for the same reason the non-metalliferous deposits are somewhat briefly described, receiving but one chapter of the twenty-eight in the book. The volume is thus in essence a condensed treatise on ore deposits; its central concept is that most ore deposits (except an important group of sedimentary origin) are genetically related to igneous rocks.

The first chapter consists almost wholly of definitions, such as ore, protore, etc., a necessary groundwork, but it forms a rather heavy introduction to the subject and is likely to dull the interest of students coming fresh to the subject; fortunately the chapter is but three pages long. A suggestive outline of the objects of economic geology, its problems, and its broader relations to petrology and geology would perhaps make a more attractive introduction. The second chapter takes us deep into the subject, namely, the classification of ore deposits. Primary ore deposits are grouped under eight major heads:

1. Deposits formed by magmatic segregation; consolidated from molten magmas.
2. Pegmatite veins; deposited by aqueo-igneous magmatic solutions.
3. Contact-metamorphic deposits; deposited in intruded rocks by fluids passing from consolidating intruding rocks.
4. Deposits of the deep vein zone; formed at high temperature and under great pressure, generally in and along fissures.
5. Deposits formed at moderate depths by ascending hot solutions.
6. Deposits formed at shallow depths by ascending hot solutions.
7. Deposits formed at moderate and shallow depths by cold meteoric solutions.
8. Sedimentary deposits; chemical, mechanical, organic, etc.

These classes are then briefly characterized, perhaps somewhat too briefly to differentiate them clearly in the student's mind at this stage of his knowledge of the subject. For example, the characterization of contact-metamorphic deposits is insufficient to distinguish them sharply from deposits of classes 4, 5, and 6.

The next eight chapters take up one by one the several classes of the scheme. They are models of clear and concise presentation.

In the chapter on the sedimentary deposits is given an interesting diagram that shows approximately what proportion of the primary ores and protores of each of the various metals occur in the eight groups of the genetic classification.

Chapters 11 to 21 inclusive deal with the more general phases of the subject, such as primary ore shoots, the origin of thermal metal-liferous waters, and so on. The chapter on Superficial Alteration and Enrichment is of course particularly good, as is to be expected of a field that the author has so notably made his own. It is somewhat surprising, however, to find that he has made no use of the newer solubility determinations of the metallic sulphides as given in Stieglitz' *Qualitative Analysis* or in Abegg's *Handbuch der Anorganische Chemie*; had he used these, rather than those of Weigel, he would have found less difficulty in reconciling them with the known facts of secondary enrichment.

The second half of the book (chapters 22 to 28, comprising 299 pages) treats of the metals and more important non-metals. The chief valuable minerals of each metal and non-metal are described, chiefly in their economic aspects, the genesis of the deposits is sketched, the age of the deposits occurring in the United States is discussed, and certain specific or distinctive features of the geology of each substance, such as sulphide enrichment in the chapter on copper, are specially considered. Although some economic geologists have objected to this mode of treatment by substances, it is an eminently satisfactory way of giving the subject concreteness to the student. As DeLaunay says, the treatment by types of deposits, in spite of important advantages, has the grave fault of scattering the descriptions of deposits of the same substance according to a system that is necessarily somewhat hypothetical and arbitrary. The general treatment of each metal or non-metal is followed by descriptions of mining districts, practically all of which are chosen from the United States. For some reason not clearly apparent the order in which they are described conforms neither with the genetic classification of the first half of the book nor with the order of their

commercial importance. In the chapter on iron, the Lake Superior deposits receive an undue amount of attention in view of the title of the book, and following what seems to have become a convention among those intrusted to teach geology, a large number of stratigraphic columns built up of many formations and members, doubtless of interest to local geologists, have been introduced, but they add little in elucidating the principles of the science. The reviewer would like to see the chapter on iron recast in accordance with the genetic classification adopted in the book. As illustrating the first category of the classification, the descriptions of the districts might then begin with the igneous iron ores of Kiruna, Sweden, which have been carefully studied by many able geologists and concerning which there is, as a result of the attrition of ideas, a solid nucleus of established fact. It seems desirable that this mode of treatment be extended to the other metals also, and that the representative districts be selected regardless of whether they are or are not in North America. Although the author has purposely chosen the illustrative districts almost wholly from North America, the procedure can hardly be commended, as it encourages provincialism and seems rather a concession to our American linguistic laziness. In the chapter on copper seven of the eighteen districts described are those containing disseminated deposits, which adds much to the amount of information presented, but does not increase the number of principles exemplified. For some of the "porphyry coppers," descriptions of types not now illustrated by the book might profitably be substituted, such as those of Mansfeld, Sulitelma, and Little Namaqualand.

In naming this volume *The Principles of Economic Geology*, Professor Emmons has given it a highly attractive title—one which arouses the expectation that the book thus distinguished will deal in a broad and stimulating way with the firmly established generalizations of the subject. If in places it deviates from the ideal suggested by its title and becomes burdened with details, these departures are after all easily forgotten in view of the general excellence of the book. The subject is accurately, clearly, and succinctly presented, and is well illustrated by numerous carefully chosen text figures. The author has achieved the plan he set himself to accomplish—to give a conspectus of the subject for advanced students of geology—and for this purpose the book is undoubtedly the best text on economic geology that has yet been written.

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